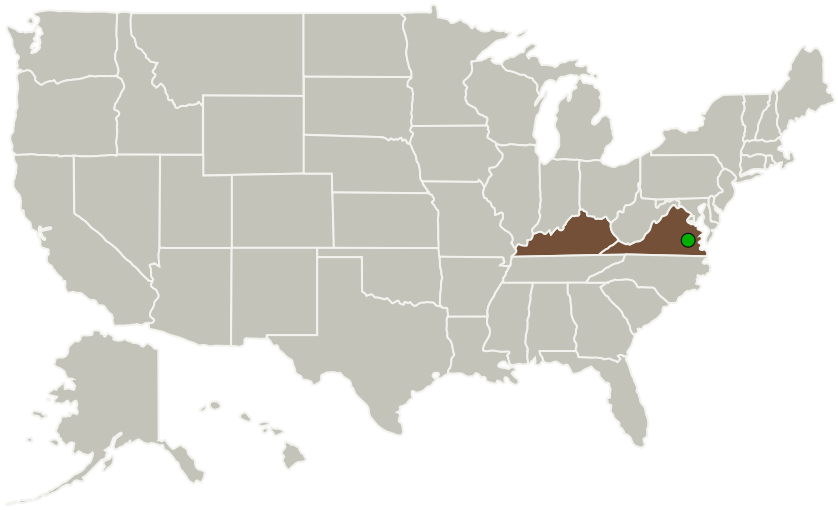
Towards Better Modeling and Simulation of Nonlinear Aeroelasticity On and Beyond Transonic Regimes, Phase I

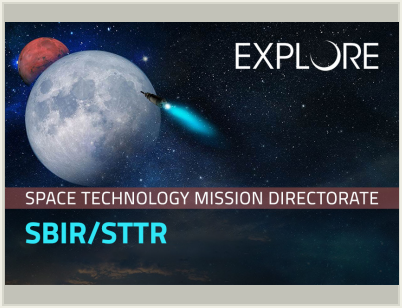
Completed Technology Project (2011 - 2011)

Project Introduction

The need to accurately predict aeroelastic phenomenon for a wide range of Mach numbers is a critical step in the design process of any aerospace vehicle. Complex aerodynamic phenomenon such as vortex shedding, shock-turbulence interaction, separation, etc. dominate at transonic and supersonic Mach numbers and hence the need to address these phenomena is of utmost importance in the modeling process. Research is proposed for the development and implementation of state of the art, large-eddy-simulation (LES) based computational models for problems in nonlinear aeroelasticity. Highly efficient and accurate subgrid-scale (SGS) models will be incorporated into the flow solver and coupled with high fidelity structure solvers to predict aeroelastic phenomena such as transonic flutter, limit cycle oscillations, etc. The SGS models proposed are based on eddy-viscosity and non-eddy-viscosity models and they will both be assessed for accuracy and robustness in the context of nonlinear aeroelasticity. The implications of the proposed work include using highly accurate turbulence models with efficient finite element models of structure to solve problems in nonlinear aeroelasticity. The application of the proposed innovations spans the range of flight, from subsonic to supersonic transport vehicles. Anticipated results include 1) the implementation of the proposed LES methodology into current aeroelastic toolset 2) application of the proposed work to large-scale simulation and comparison with experiment and lower fidelity RANS-based aeroelastic simulations and 3) advancement of the state of knowledge for nonlinear problems in aeroelasticity.

Primary U.S. Work Locations and Key Partners





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Organizations Performing Work	Role	Type	Location
Advanced Dynamics, Inc.	Lead Organization	Industry Minority-Owned Business	Lexington, Kentucky
Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia

Primary U.S. Work Locations	
Kentucky	Virginia

Project Transitions

February 2011: Project Start

September 2011: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/139506)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Advanced Dynamics, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

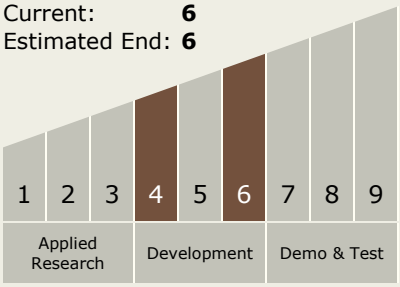
Carlos Torrez

Principal Investigator:

Patrick Hu

Technology Maturity (TRL)

Start: **4**
Current: **6**
Estimated End: **6**



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Technology Areas

Primary:

- TX15 Flight Vehicle Systems
  - TX15.1 Aerosciences
    - TX15.1.3 Aeroelasticity

Target Destinations

The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System